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Interactive comment on "The influence of a vegetated bar on channel-bend flow dynamics" *by* Sharon Bywater-Reyes et al.

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This is an interesting study, which examines the impact of different vegetation types and densities on flow through a channel with a vegetated bar. The topic is relevant and the work builds on a significant literature in this area. While the work seems rigorous and of good quality, there are some details of the methodology that would benefit from clarification. Furthermore, the data could be better presented to improve clarity.

Major Comments:

Representation of vegetation: The authors raise the issues regarding the use of roughness coefficients for representing vegetation. Accordingly, they adopt a much more suitable drag-based approach. However, there are still potential limitations with this approach. In particular: the parameterisation of drag coefficient, the distribution of drag elements in space and the assumption of a logarithmic profile may represent sig-

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nificant limitations of the study and could receive more attention in the text (see specific comments below)

Methods: There are a number of details regarding the numerical methodology which are currently not presented, but which may have a significant impact on the results (e.g. average drag force equation, grid size & type, relative errors, approximate depths, delineation of bar).

Figures & Data: Figure 2b could be presented more clearly. Figures 5-7 could be made clearer, but also some data is referred to which is not present in these figures (higher Q values for XS1 &3).

Specific comments: Pg 5 Ln 5: Is A_S defined? Appears in supplementary data, but I'm not sure it is defined in the main text?

Pg 6 Ln 12: What was the grid size used in the simulation? Was it constant for the whole domain? Was bank (wall) shear stress included too? (i.e. cells with wall boundaries too).

Pg 6 Ln 20: In Table 1 it would be helpful see the relative magnitude of errors. Errors of 0.18m in WSE and 0.36m/s in velocity seem large, but may not be relative to the mean values? Table 1 does also not provide a comprehensive overview of the calibration. E.g. which different values were used for C_d? What was the sensitivity to this value? The two LEV values are an order of magnitude apart, were any other values in between tested? What was the rationale for picking these values? Also, the table seems to suggest that a model without any vegetation performed better than the model with vegetation?

Pg 7 Ln 11: These relaxation figures mean very little out of context. Please provide brief explanation of which variables they correspond to.

Pg 7 Ln 15: Why were you unable to maintain a curvilinear grid? This is unclear. Which nodes overlapped and why? Was the model run in Cartesian grid? Section 2.2 seems

to suggest it was curvilinear (Pg 6, Ln 5). If values were converted between grids, how was this done, i.e. interpolation methods, grid sizes etc.

Pg 8 Ln 7: Presumably the model uses an equation in terms of drag force per unit volume? It would be useful to include the exact form here.

Pg 8 Ln 10: I agree with the authors that C_D=1 is a common first-order approximation, and probably does an ok job for the lower section of the plants where objects are likely to be cylindrical. However, for trees, with complex foliage I would expect this assumption to be less accurate. Therefore, it might be worth reflecting on the accuracy of the model at different discharges

Figure 3: How was the vegetated bar delineated? Current vegetated extent?

Pg 8 Ln 13: If I am correct, a height-dependent value of A is used (from Figure 2). However, regardless of depth, the near-bed vegetation geometry will not change. Therefore, in terms of defining near-bed processes linked to sediment transport, I wonder what the impact is of changing A_c as depth increases, given that this impact may only be significant towards the top of the flow? Above a certain height, does the effect of area on bed-processes diminish?

Pg 8 Ln 12: How does the grid resolution compare with the stem density? Are the effects of a single stem artificially 'smeared' over many stems? If so, particularly for low vegetation densities, the flow patterns may not correspond well with single, isolated large area blockages, which will have a very different impact to wide-spread small blockages.

Pg 8 Ln 13-14: The flow will typically not be logarithmic where there is vegetation present. Therefore, what errors does this assumption introduce? Are the results valid?

Pg 9 Ln 5: 20 stems per square metre seems very dense for saplings and trees? Also, for such densities, is it still valid not to consider the mass blockage effect of the vegetation?

Pg 9 Ln 32: Decreasing velocities in the thalweg is surprising –but seems to correspond to additional flow along a separate channel to the right of the vegetated bar? It seems this is quite an important aspect which affects other results too (e.g. flow deflection into this channel for certain vegetation conditions). This could be made clearer within the discussion which frames the problem as a simple channel bend with vegetated bar.

Pg 9 Ln 32: Are the observed decreases/increases in velocity significant with respect to uncertainty/error?

Figures 5-7: These graphs are not easy to read. I wonder if colour could be used in addition to line style, or results separated for density & type? Furthermore, it is unclear why lateral velocities are not reported for XS2?

Pg 14 Ln 9: Would be helpful to show the data for each XS for Q>10, not just XS2.

Pg 14 Ln 16-17: As mentioned above, it seems the side channel to the right of the patch plays an important role in conveying discharge, particularly for higher Q values. Is this process more important than channel bend processes?

Pg 15 Ln 8-10: I agree that results show that the impact of vegetation increases with Q, but I do not think results show that the vegetation begins to impact on channel-bend hydraulics for Q>Q2. It seems to me that even at Q=Q2 there are significant differences in velocity distributions that may, over a long period cause significantly different channel morphology?

Pg 15 Ln 16: I do not think the results show any evidence of 'linear' trends?

Pg 16 Section 4.2: It would be good to quantify the correlation between sediment and vegetation, beyond the visual observation in Figure 8. Also, these patterns demonstrate the limitation of assuming constant vegetation density across the bar as mentioned earlier.

Pg 18 Ln 21: The authors mention the presence of bars with vegetation/no vegetation. This study investigates the difference of plant type (age) but this in itself is related

to channel morphology (e.g. plant succession over time) and flood discharges (e.g. destroying plants or creating new bars). It would be interesting to think about how the model could be developed to introduce different vegetation types, depending upon bar age, etc.

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